State of California

Memorandum

TO Kean S. Goh, Ag. Program Supervisor IV
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Dale : February 13, 1996

Place :

From : **Department of Pesticide Regulation** - 1020 N Street, Room 161
Sacramento, California 95814-5624

Subject : DEFINITION OF 'UNEQUIVOCAL DETECTION METHODS' FOR THE PURPOSES OF SB810

Senate Bill (SB) 810 amended Food and Agricultural Code section 13149(d) to allow the finding of a pesticide chemical by a single analytical method if this method provides 'unequivocal identification' of the chemical. The attached document recommends the criteria by which a method will be determined to provide unequivocal identification.

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Attachment

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Summary

The basic requirement for an unequivocal detection is that the target compound can be distinguished from potential interferences present in an environmental sample. This can be achieved by two routes:

a) The method is known not to show any significant interferences from other chemicals. Example: an enzyme-linked immunosorbent assay (ELISA) that has been tested for cross-reactivity.

b) The method uses a detection process that can be used to identify the chemical structure of the compound. Example: mass spectroscopy (MS) or infrared (IR) spectroscopy.

Any method that does not meet the above criteria will require a confirmation analysis by a second method or a second laboratory. Detection methods that meet the above criteria are likely to provide unequivocal detections, but this is influenced by the operating conditions and the nature of the chemical analyzed. Therefore, the decision has to be made on a case-by-case basis. A specific analysis method will only be recommended to the branch chief as an unequivocal method according to AB 2021 if both the chemist 'in charge of the method development and the senior environmental research scientist (ERS) assigned to the project sign off on this designation.

To provide a frame of reference, a short description of the problem that is behind the need for unequivocal detection is attached here.

Statement of the problem

In order to minimize any negative regulatory consequences due to an erroneous detection of a pesticide, one needs high confidence that the analysis procedure does not produce spurious positive results (caused by interferences from other compounds, sample or laboratory contamination, etc.).

Doubt about sufficient confidence arises from the non-specificity of traditional gas chromatographic (GC) or liquid chromatographic (LC) analyses which are the most common methods for the measurement of pesticides in environmental samples. GC or LC systems just separate the components in a mixture. These components will elute from the chromatograph in a sequence that is determined by the type of separation column used in the instrument and by the operating conditions. The separated components then pass through a detector where they are recorded and quantitated. The vast majority of GC or LC detectors are completely non-specific; they respond to any compound that elutes from the chromatographic column.

The only means of identification is the time that a compound needs to traverse the separation column in the chromatograph. The peak assignment is made solely by inference: because calibration runs show that pesticide X eludes at time Y, any peak observed at time Y for any sample is then assumed to be caused by pesticide X. It is obvious that the more compounds present in an environmental sample, the more tenuous this inference becomes, as the likelihood of an interference increases with the number of compounds in the mixture. This is especially true for environmental samples with an unknown exposure history.

Old solution

The original version of Assembly Bill (AB) 2021 stated that every detection of a pesticide required a second analysis by a different method or a different laboratory to provide confirmation of the initial positive analysis result.

Because the number of compounds present at parts per billion (ppb) or sub-ppb levels can be large in environmental samples, more false positives will be generated as the detection limit gets lower. Consequently, that more confirmatory analyses will be required. However, if a false positive is caused by a low-level interference in the original sample or by contamination in the field (and not introduced inside the laboratory), an analysis by a second laboratory will result in a false positive also. Only a truly different second method might help resolve such a case.

New solution

The best way to be highly confident of an analysis result is to use a detection method that can uniquely identify a chemical. Any such method that can distinguish the target compound from potential interfering compounds in a sample is designated as unequivocal and makes the need for a second analysis superfluous.

[Note: An unequivocal detection minimizes the error caused by interferences; it does not solve the problem of sample contamination. Only proper quality control procedures can minimize the risk of that error.]

When to declare an analysis method as unequivocal

The basic requirement for an unequivocal detection (that the target compound can be distinguished from interferences) can be achieved by two routes:

a) The method is known not to show any significant interferences from other chemicals. Example: an enzyme-linked immunosorbent assay (ELISA) that has been tested negative for cross-reactivity.

b) The method uses a detection process that can allow identification of the chemical structure of the compound. Example: mass spectroscopy (MS) or infrared (IR) spectroscopy.

Even though these detection methods provide the capability to identify a chemical, it does not imply that they will be able to do so unequivocally under all operating conditions or for all chemicals. Take mass spectrometry as an example: one can either acquire a whole mass spectrum, scan selected mass ranges, or just look at one or more selected mass values. The less information one gathers, the larger the possibility of an erroneous positive identification becomes. In identifying a chemical spectroscopically, it is as important to show that there are no peaks where there shouldn't be any as it is to show that there are peaks where there should be.

Therefore, the final determination as to whether a given analysis method can be considered 'unequivocal', will not be based generically on the detection method used, but must be made on a case-by-case basis in consultation with the chemistry laboratory. Only the explicit operating instructions contained in a written and approved method, together with the supporting data of the method validation, will provide enough information to make a proper decision. Thus a specific analysis method will only be recommended to the branch chief as an unequivocal method according to AB 2021 if both the chemist in charge of the method development and a senior ERS sign off on this designation.